

Lake Erie harmful algal bloom citizen-assisted research – a broad partnership

George S. Bullerjahn, COHH Director
Bowling Green State University



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- Greg Dick, University of Michigan
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National Institute of
Environmental
Health Sciences



Microcystis HABs in Lake Erie



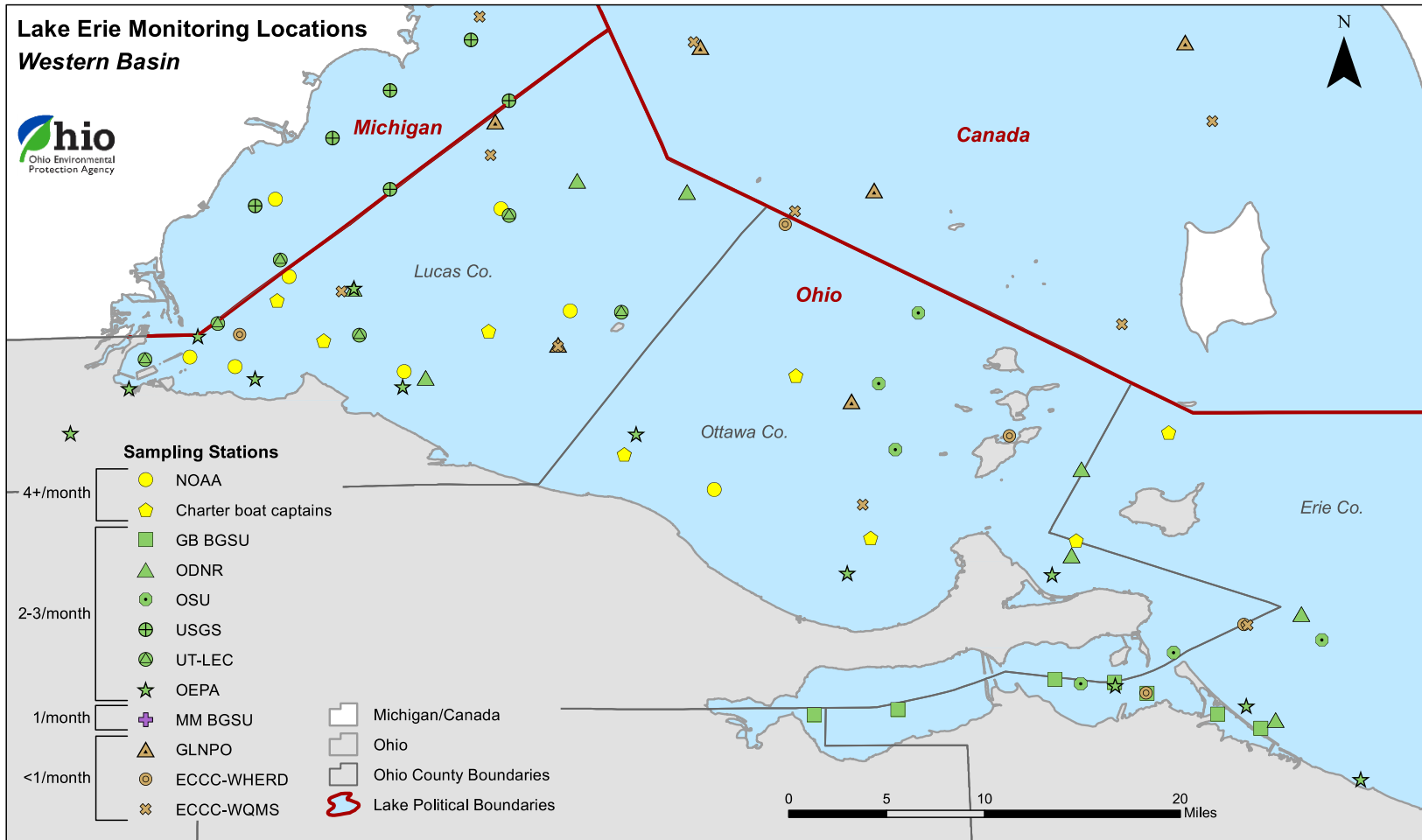
Western Lake Erie, September 26, 2017

Toledo Water Crisis: August 2014



Microcystins (liver toxins) in excess of 1 ppb shut down water for 400,000 people

Routine Lake Erie sampling



Expanding that reach to ask additional questions:

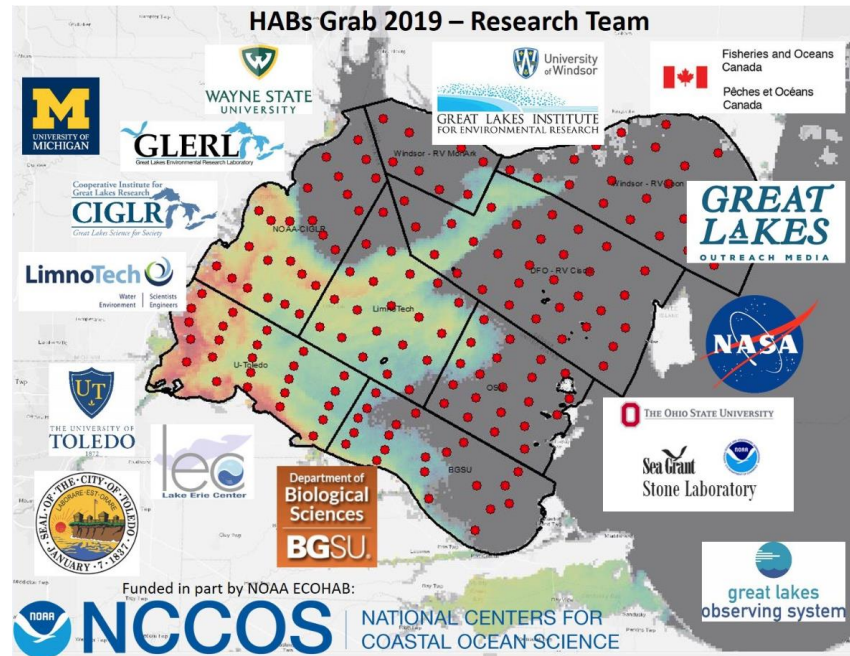
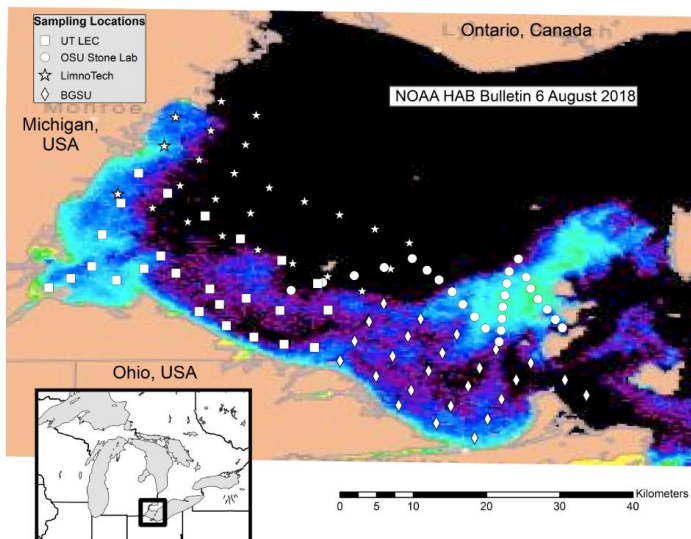
- HABs Grab
 - One-day sampling and analytical event to understand links between toxicity and biomass
- Charter boat captains
 - Provides additional sampling depth
- Winter sampling with the US Coast Guard
 - Allows understanding of C, N and P cycling in the 'off-season'
- Not exclusively citizen science, but we rely on citizens and non-scientists to meet our objectives

HABs Grab

- Need to know relationship between biomass and toxicity
- Green water doesn't always mean toxic water
- HABs Grab – a one-day event to assess:
 - Toxicity
 - Diversity of toxins
 - Total biomass of cyanobacteria
 - Genotypes of bloom forming cyanobacteria

HABs Grab: 1-day intensive sampling effort in the western basin (August 7, 2019)

ECOHAB HABs Grab 9 August 2018



HABs Grab: 1-day coordinated intensive sampling effort in the western basin

- Goal: to estimate total peak bloom microcystin mass in the western basin
- All samples collected (2 meter integrated surface) and processed with same methods (Lake Erie Center, U Windsor).
- MC ELISA – Toledo Water Plant; MC LC-MS/MS – Wayne State
- Chlorophyll – U Toledo
- Nutrients – Ohio State Stone Lab
- qPCR toxin genes – BGSU
- DNA sequencing (*mcyE*, *16S*)– US EPA & BGSU
- Secondary metabolites – ECCC
- Activities were widely reported in local news







A PUBLIC UNIVERSITY FOR THE PUBLIC GOOD.

BGSU



Beach space needs for
extractions in purple.
Thank you

hEC003

hEC008

hEC011

hEC020

hEC007

hEC013

hEC019

H6W001
5090

H6W007
3092

H6W003-N004

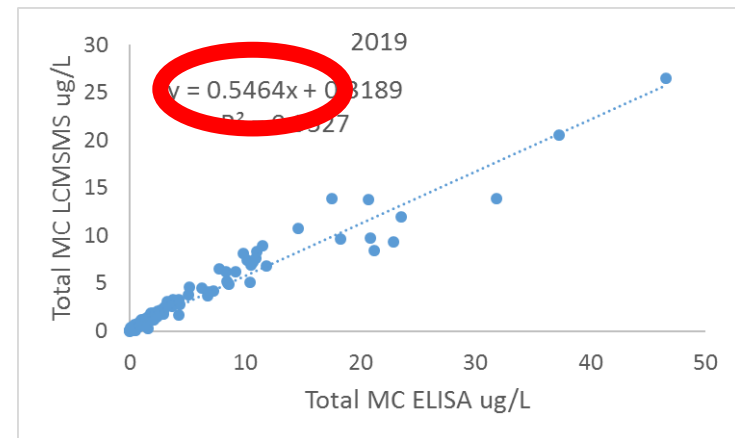
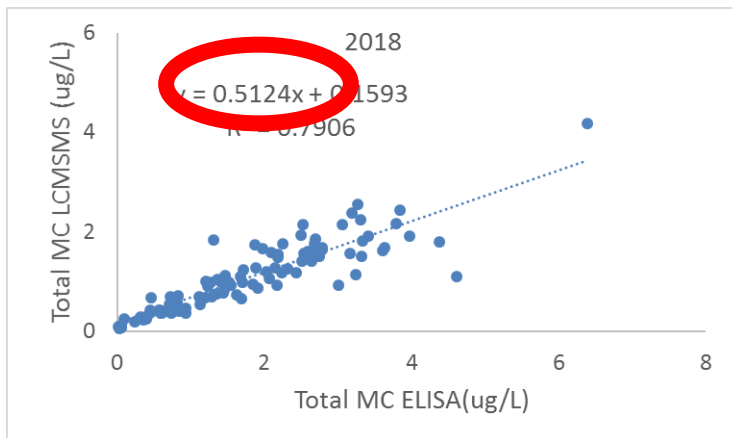
H6W013

H6W19

H6W25

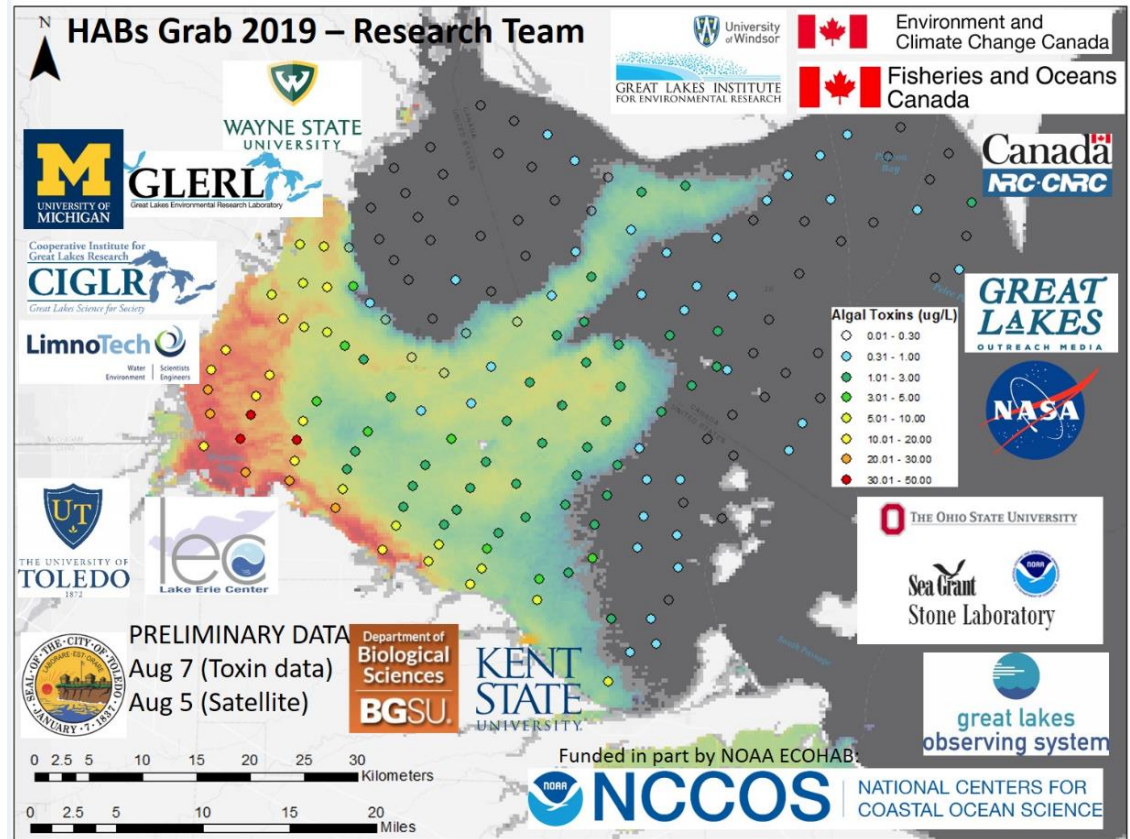
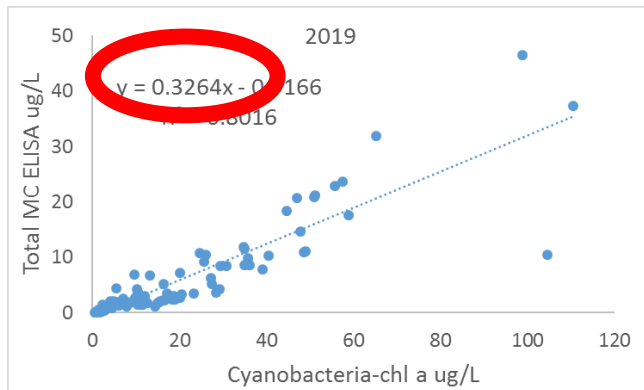
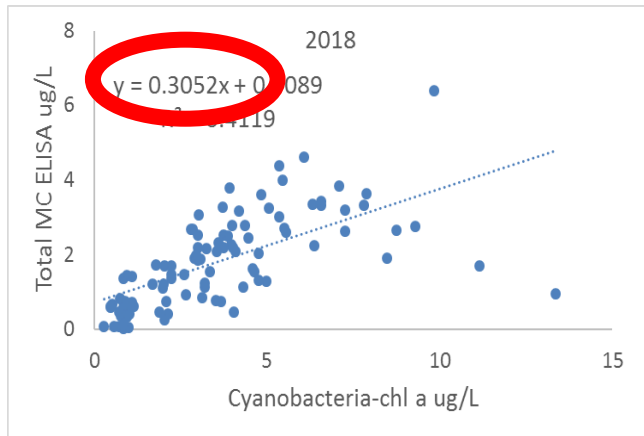
H6W

Agreement between ELISA and LC-MS/MS



- All samples freeze/thawed 3 cycles and filtered (GMF) at Stone Lab
- Samples split
 - ELISA at Toledo Water Treatment Plant using Abraxis Automated ELISA machine
 - LC-MS/MS at Judy Westrick's lab at Wayne State University
- ELISA was about twice high as LC-MS/MS
- Same relationship between years

MC correlated with cyanobacteria biomass both years

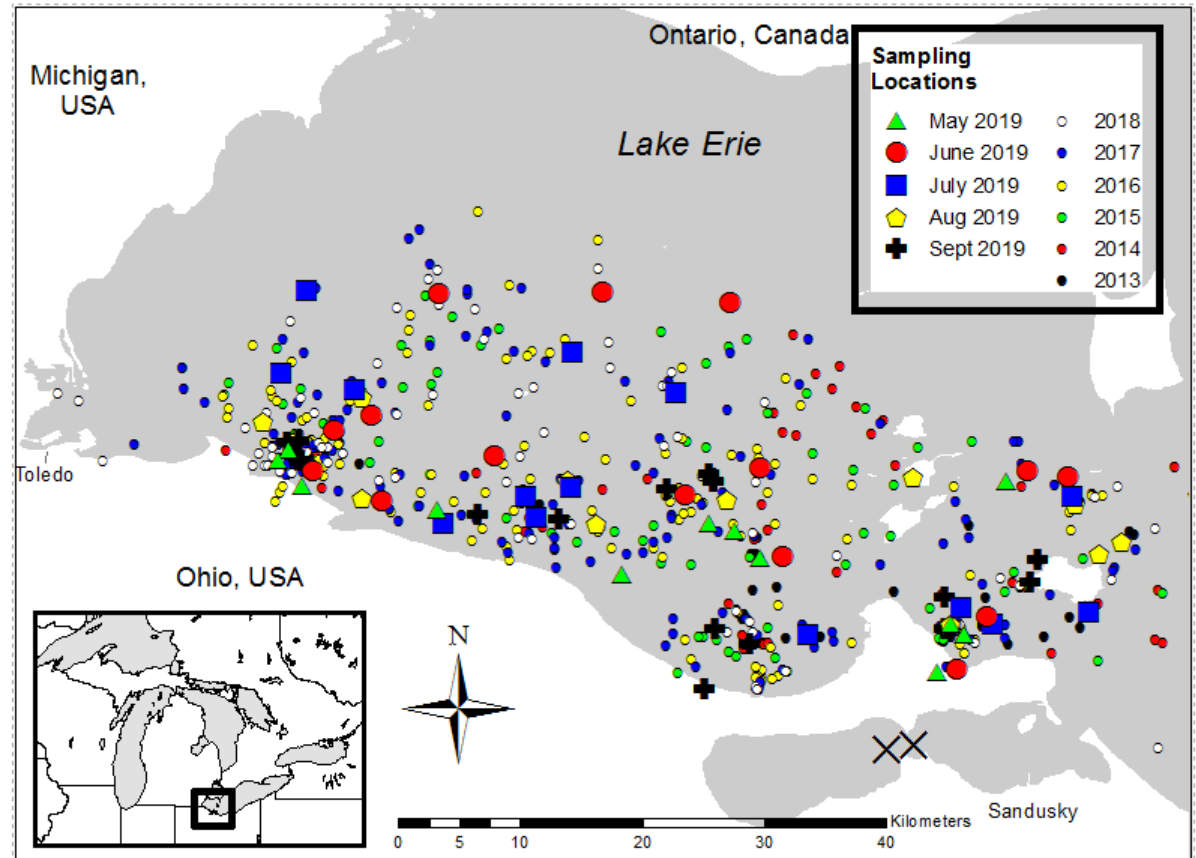


HABs Grab is one day

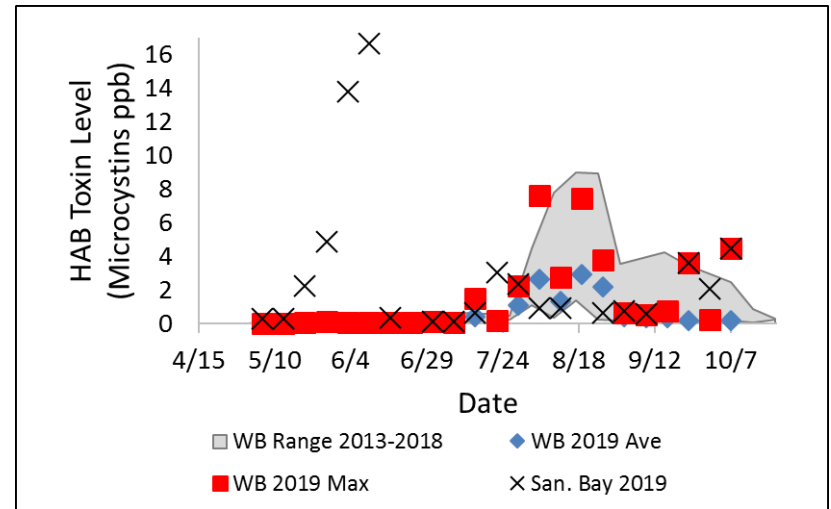
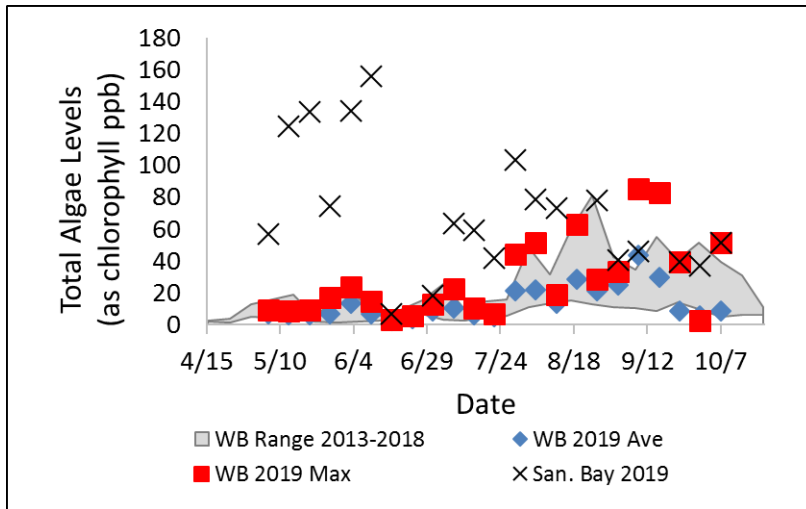
What additional opportunities exist for the whole summer?

Charter boat captain sampling

- May 5 – Oct 7
- Added 3 new captains
 - Added Sandusky Bay

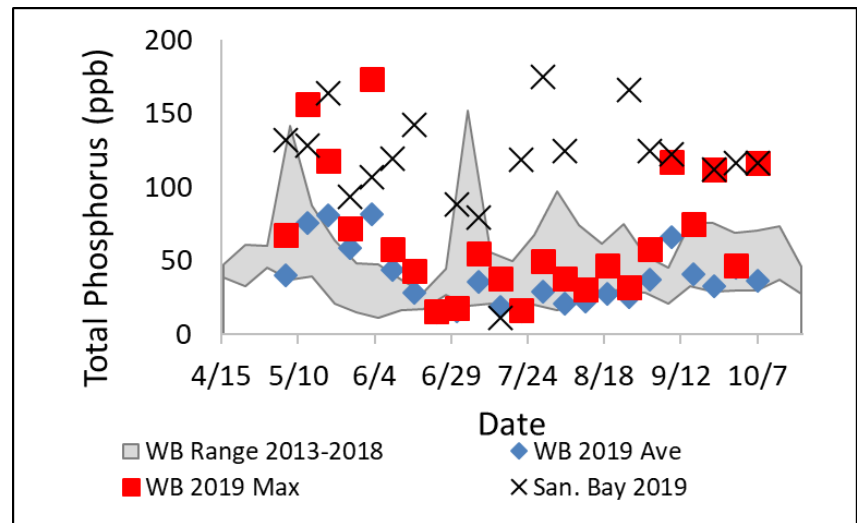
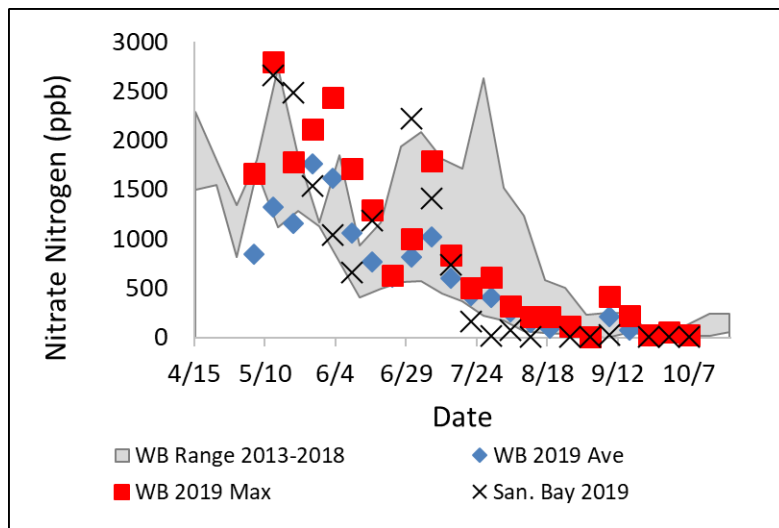


Charter captain data summary: Weekly fact sheets allow them to compare Lake Erie year-to-year



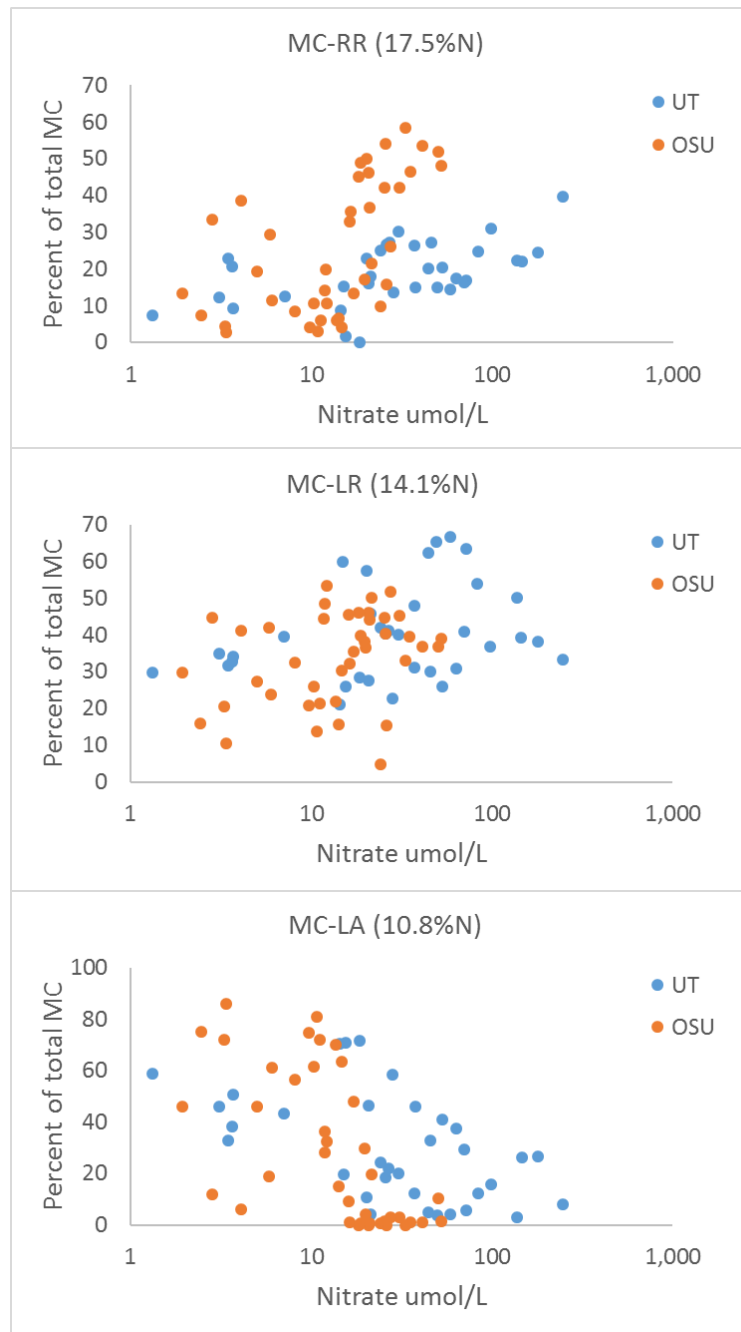
Also: Total P, DRP, TKN, Nitrate, Ammonium, Silicate, FluoroProbe,
Secchi disk depth, Water temperature

Nutrients from the captains



Patterns of MC Congeners (2018)

- MC-RR (17.5%N) positively correlated with N
- MC-LR (14.1%N) showed no correlation with N
- MC-LA (10.8%N) negatively correlated with N
- Differ congeners have different toxicity



Winter sampling with the USCG



LCDR William Woityra,
USCGC Neah Bay

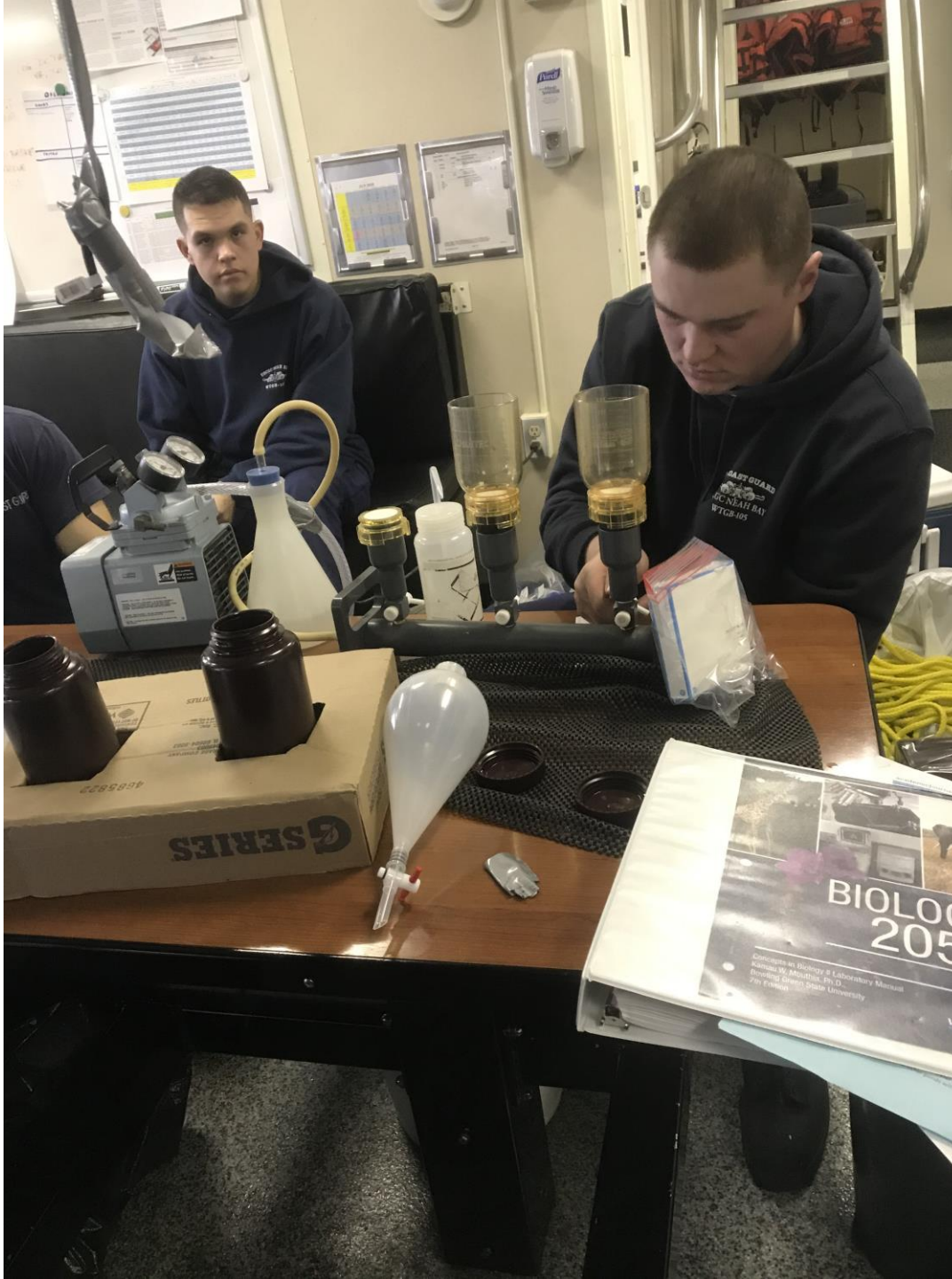
Coordinator – Mike
McKay, BGSU and U
Windsor



Crew sampling during Lake Erie trips

The *Neah Bay* galley and crew's mess becomes a lab and classroom





Participating USCG crew are enrolled in a BGSU General Education Biology lab course

A taste of University expectations for those planning on college after deployment

Ice cover extent drives phytoplankton and bacterial community structure in a large north-temperate lake: implications for a warming climate

B. F. N. Beall,^{1†} M. R. Twiss,² D. E. Smith,^{2‡}
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⁶USCGC Neah Bay (WTGB 105), Cleveland, OH, USA.

propose that isothermal mixing and elevated turbidity in the absence of ice cover resulted in light limitation of the phytoplankton during winter. Additional insights into microbial community dynamics were gleaned from short 16S rRNA tag (Itag) Illumina sequencing. UniFrac analysis of Itag sequences showed clear separation of microbial communities related to presence or absence of ice cover. Whereas the ecological implications of the changing bacterial community are unclear at this time, it is likely that the observed shift from a phytoplankton community dominated by filamentous diatoms to smaller cells will have far reaching ecosystem effects including food web disruptions.

Introduction

Lakes and reservoirs serve as rapid responding sentinels of human influence on the natural environment (Adrian *et al.*, 2009; Williamson *et al.*, 2009) rendering them powerful tools to advance our understanding of a

Summary

- Three activities targeted for specific needs
 - Biomass/toxicity relationships (HABs Grab)
 - Enhanced sampling during bloom season (Charter captains)
 - Fate of nutrients and biomass in winter (USCG crews)
- Coordinated activities between Universities, agencies, private sector, service personnel and citizens
- Requires standardization of methods, broad training and incentives for participation when needed

Questions?

<https://www.bgsu.edu/great-lakes-center>

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